Danish pilot study - Health care building

National report - Denmark. Final report, June 2007

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National report – Denmark

Final report, June 2007

Energy Performance Assessment
of Existing Non-Residential Buildings

Report Number:
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Danish pilot study

National report – Denmark

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Contents

1 Introduction

This is the Pilot study National report performed in the frame of Work package 4 of the EPA-NR project.
The pilot Study consists of three Pilot projects for non residential buildings:

- Pilot project for one education building
- Pilot project for one offices building
- Pilot project for one health care building

Pilot projects are real buildings for which the EPA-NR method was applied.

1.1 Goal of pilot study

The goals of pilot study are:

- The evaluation of EPA-NR method , including the building diagnosis and the EPA-NR software
- The assessment of Energy Performance of the building and creating an useful Energy Performance Advice for the owner of the building

For the first objective, an evaluation procedure was defined and a questionnaire [1] was performed. The questionnaire was filled for each pilot project by the person who applies the EPA-NR method to the building.

The analysis of all the questionnaire answers was the basis of the evaluation of EPA-NR method and the recommendations of modifications.
The evaluation of EPA-NR method including recommendations for modifications are described in a specific (internal) report [2].

The assessment of Energy Performance of the building indicates the actual performance of the building and some proposed energy saving measures to reduce the energy consumption taking into account the indoor environment, investment costs, payback times and technical feasibility.

The assessment of Energy Performance of the pilot projects including a set of energy saving measures is described in this report.

The results of the pilot study will serve as demonstration for dissemination.

1.2 Structure of the report

The report is divided into three chapters:

- Chapter 2 concerns the pilot project for education sector
- Chapter 3 concerns the pilot project for offices sector
- Chapter 4 concerns the pilot project for health care sector

The characteristics of the building surveyed are described in paragraph 1 of the chapter.

The results of building diagnosis including a description of actual situation of the building and energy demand calculation using EPA-NR software are described in paragraph 2 of the chapter.

Paragraph 3 of the chapter presents a number of scenarios to improve the energy performance of the building, for each scenario, the energy saving, the investments and payback time are given and finally the most appropriate scenario as an advice to the owner is described.

2 Health care building, Møllegården care center

2.1 Project summary

Care Centre Møllegården, Gladsaxe
Sheltered Housing, elderly people's rest home and day centre. Contractor: Gladsaxe Municipality.

Type of building: Health care Location: Scattered urban environment Owner: Public Year of construction : 1977 Total gross area (m²): 10,139 m² Total conditioned area (m²): 9,562 m² Building occupancy 24 hours per day all year Number of occupants: about 140 (106 elderly people plus staff).	Short description: The scattered buildings at Møllegården consists 50 individual, sheltered row houses and a 2 floor building with rooms for 56 elderly people's rest home. The housing is owned by Gladsaxe municipality. The buildings are oriented along a North-South axis and the rooms are thus oriented either East or West. There are three primary zones: the residential area, the common areas for day care and the kitchen area Construction: Facades are made of concrete elements with light parts covered with wood on the external and boards at the internal faces. Roof is covered by roofing boards. The glass in the windows is tradi-

tional double pane thermo windows.

Heating / cooling/ ventilation/ lighting: Heating is via a local district heating plant. There are three boilers of which only two are running. The inhabitants do not want energy saving bulbs. There is mechanical ventilation in the kitchen and common areas for day care.

Energy management: The energy management system needs a general update and eventual adjustment.

Energy consumption year 2005 :

	The building (*According the bills*)	National average (*if known*)
Fuel	182.3 kWh/m²	143 kWh/m²
Electricity	48.2 kWh/m²	46.1 kWh/m²
Water	0.73 m³/m²	0.75 m³/m²

Previous refurbishment : none

Planned refurbishment: The existing elderly people's rest homes are located in the two floor building and its physical framework is preserved during the renovation. Three apartments will be joined together to two new apartments, making the centre apartment into a bathroom suited for disabled people. The dwellings are light and pleasant and will be made with focus on flexibility and individual adaptation. From the dwellings at the ground floor there is access to a terrace.

In conjunction with renovation of the living conditions, the building's energy performance will be upgraded.

The Care centre Møllegården and the surrounding 50 elderly dwellings are constructed in 1997 and appears with a "main street" in a village-like environment. Using a system of foot-paths and pedestrian tunnel it is possible access the centre facilities all year around.

The centre has 56 dwellings for elderly people distributed on two floors. In connection to Møllegården there is a senior citizen café, a day care centre for elderly people with a physiotherapy and occupational therapy section.

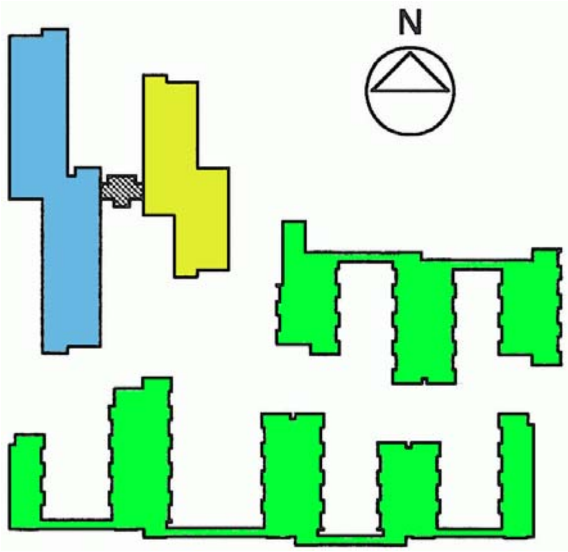
2.2 Audit of the building

2.2.1 Actual situation: measured energy

Facades

The major parts of the facades are covered by a wooden panelling that needs replacement. Adding a new facade covering will offer the possibility of adding additions insulation to the exterior side of the facades. The size of the roof eaves are plenty to give full protection for the new facade with additional insulation.

The facades in the sheltered homes are decided to be straightened and will thus result in a decrease in facade area. The new straight facade should have an insulation level of today's standard.



Plan of Møllegården. Green: Elderly peoples sheltered home; Blue: Elderly peoples nursing home; Grey: Connection building; Yellow: Service facilities, e.g. physiotherapy, kitchen, laundry, offices, OT ward, restaurant, etc.

Doors

All doors to the sheltered homes and most of the other doors are in a poor condition and with traditional double pane glazing. The doors are broader than standard doors to give access for wheel chairs and though heavier that a standard size door. It should be considered to replace the doors with aluminium doors to reduce the weight and decrease the wear on the hinges in the future. It should be noted that broad doors are more expensive than standard size doors, and this should be taken into account when calculating the investment needed for replacement of the doors.

Windows

Some windows have previously been replaced by triple pane glazing without low-e coatings. It will not be cost effective to replace these windows, but when they need replacement anyway, it should be to double pane glazing of today's energy standard.

Bay windows

There are some bay windows in the care section of the estate, and these do possibly have limited insulation at the top and bottom. It will be easy to increase the insulation level of these bay windows as the facade covering is going to be replaced anyway.

Floors

In general the insulation level of the floors is expected to be lover than today's standard, but it is estimated being too expensive to improve it. All bathrooms however will be renovated and this is an obvious possibility for improving the insulation level under these sections of the floors. This will be an especially good investment as the bathroom floors all have floor heating and thus high heat loss.

Roofs

There is access to the roof insulation from the gable of care sections. If there is enough room for additional insulation without adding to the height of the roof, this would be a favourable energy saving measure.

The roof covering needs to be maintained and in some places replaced. If the roof covering is decided to be replaced, and there is lack of space for additional insulation in the attic, this would be the perfect time for adding to the roof height and installing additional roof insulation.

Corridors
Corridors connect the different sections of the estate. These are heated by convectors placed underneath the ceiling, but this is a relatively inefficient location. Further the ceiling is pitched with the pipes located underneath it. If the convectors are moved down along the wall as one layer radiators and the ceiling is lowered to cover the pipes, the heated volume will decrease – and thus the energy consumption - and the comfort level will increase.

Solar protection
All windows in the nursing and service sections, except those facing South and North, have fixed horizontal overhangs. This provides solar protection but dramatically reduces the availability of daylight. Removal of the overhangs in conjunction with the planned renovation will improve the daylight conditions and could be combined with movable solar shading as a more energy optimized solution.

Pumps
A large number of the pumps in the heating and domestic hot water distribution systems are old and can easily be replaced by new, electronic pumps with much lower electricity consumption.

Burners
There are three burners, two natural gas burners and one oil burner in reserve. One gas burner has been modified to be a condensing type and one is the original type. It is recommended to make the same modification to gas burner no. 2.

Lighting
In general lighting needs to be revised. The lamps are equipped with grids or opal screens that reduce the light yield. Removal of the grids and installation of reflectors in wooden lamps will increase the efficiency of the lighting installation.

Domestic hot water circulation
The temperature in the circulation strings of the distribution network of the domestic hot water is at 52 °C. This temperature can be decreased without causing any problems with Legionnaires' disease as the temperature and the water flow in the hot water tank is sufficiently high.

2.2.1.1 Heating consumption

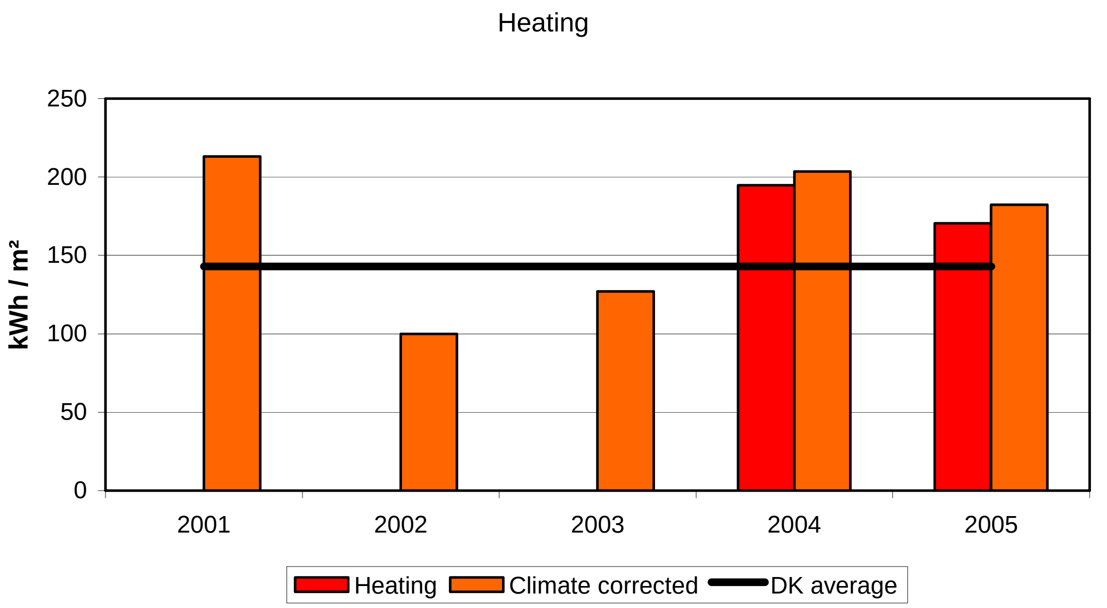


Figure 1. Heating consumption in kWh/m² in 2004 and 2005 (meter reading and climate adjusted respectively) and the Danish average consumption in buildings used for similar purpose and size. The degree-day independent heating consumption constitutes 20 %.

There have been large variations in the hating consumption at Møllegården over the past years that can not be explained by any logic reasons.

2.2.1.2 Electricity consumption

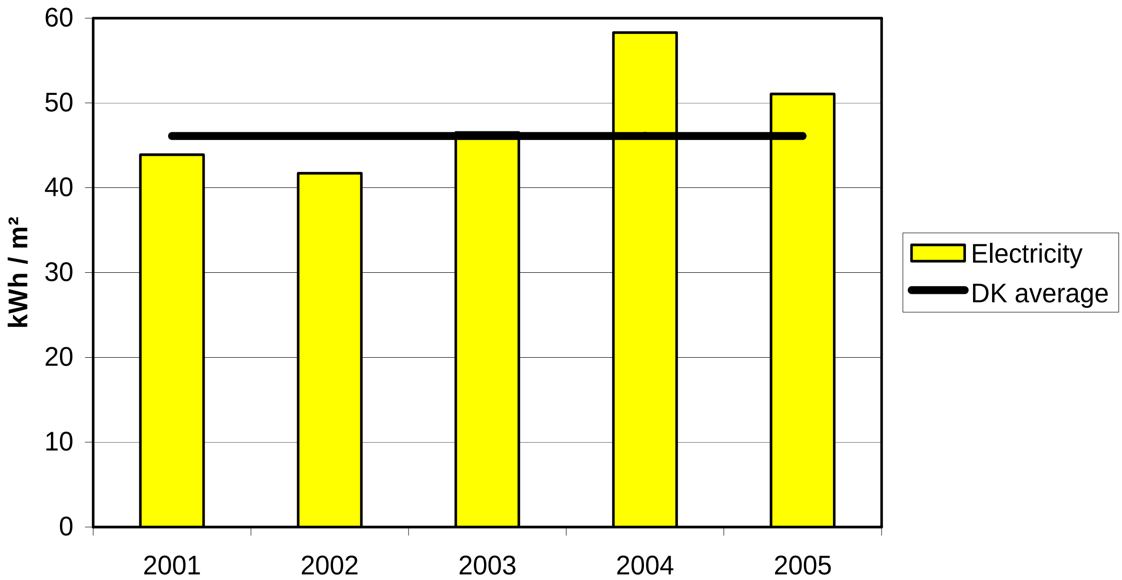


Figure 2. Electricity consumption in kWh/m² in 2004 and 2005 and the Danish average consumption in buildings used for similar purpose and size.

2.2.1.3 Water consumption

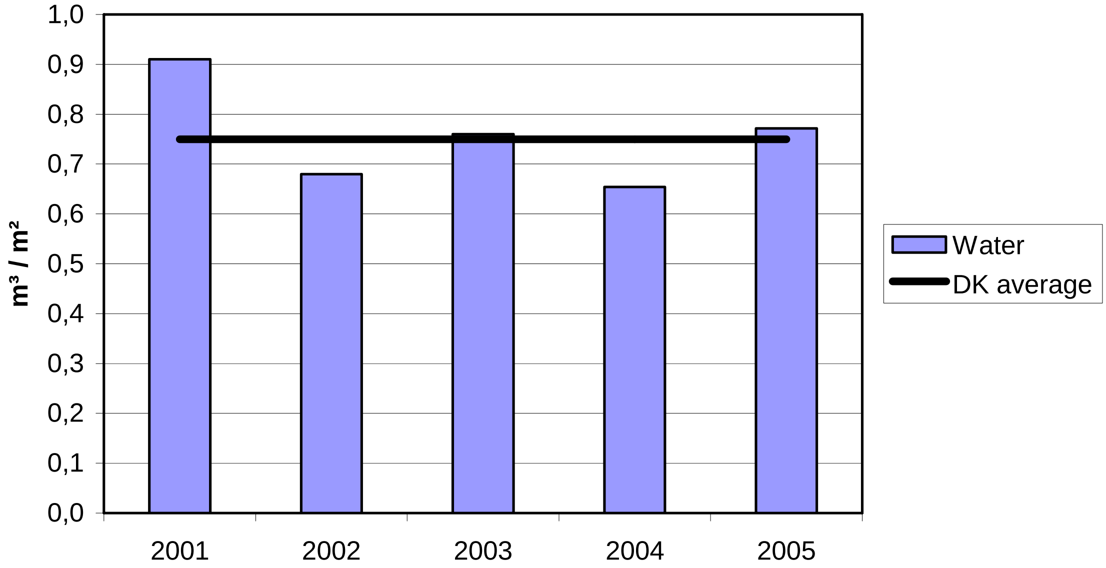


Figure 3. Water consumption at Møllegården in 2004 and 2005 in m³/m² and the Danish average consumption in buildings used for similar purpose and size.

In 2005 the domestic hot water consumption constituted 1758 m³ (28 %) of the total water consumption.

Energy consumption in the interest of EPA-NR process: presentation of figures about relevant energy consumption (if available).

2.2.2 Calculating energy 'demand' using EPA-NR software based on actual situation

2.2.2.1 Energy characteristics of the building model (global)

The energy performance was calculated under standard conditions with the EPA-NR software. For the EPA-NR calculations, the building was divided into the following four zones:

1. Zone 1: Service centre (1790 m²),
2. Zone 2: Nursing centre (2930 m²),
3. Zone 3: Sheltered dwellings (3180 m²),
4. Zone 4: Connection building (120 m²).

List of energy uses:
Zone 1: heated and mechanically ventilated,
Zone 2: heated and naturally ventilated,
Zone 3: heated and naturally ventilated,
Zone 4: heated and naturally ventilated.

Operational parameters used for the calculation:

	Zone 1	Zone 2	Zone 3	Zone 4
Heating temperature set point	21 °C	23 °C	22 °C	20 °C
Cooling temperature set point	-	-	-	-
Operation time for heating/year	8760 h/a	8760 h/a	8760 h/a	8760 h/a
Operation time for cooling/year	-	-	-	-
Operation time for ventilation/year	8760 h/a	-	-	-
Operation time for lighting/year	6570 h/a	6570 h/a	3285 h/a	8760 h/a

Input data used for the calculation is found in Appendix 2 as documentation produced by the EPA-NR tool.

2.2.2.2 Results

Primary energy demand and CO_2 emission of the building

Primary energy consumption of the building: kWh/m²/year	CO_2 emission of the building: kg/m²/year
183.02	39.3

Final energy demand, primary energy demand and CO2 emission by energy carrier

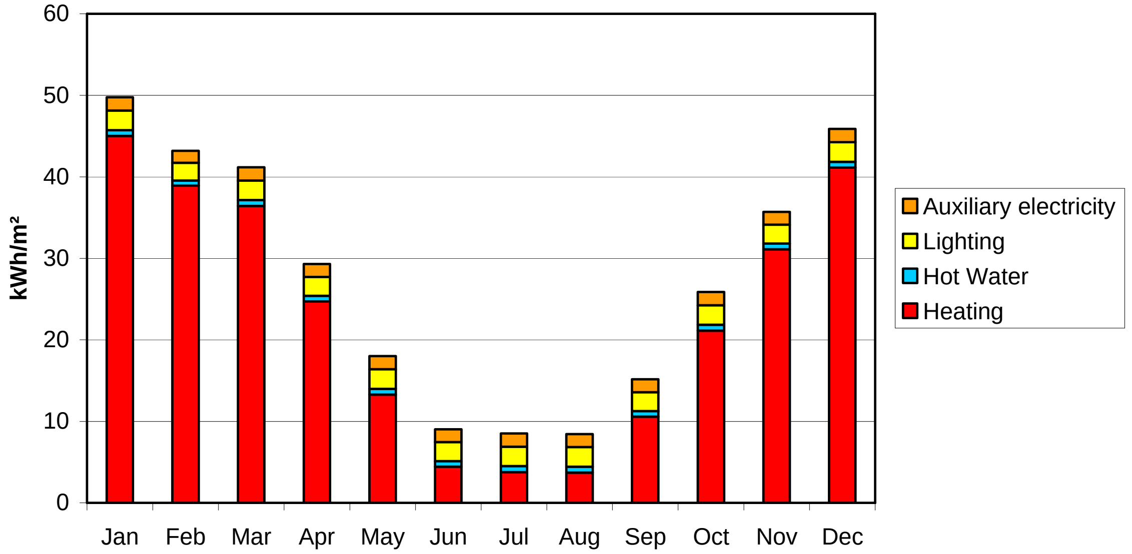
	Annual final energy consumption* of the building per fuel type:	Primary energy consumption of the building: kWh/m²/year	CO_2 emission of the building: kg/m²/year
Natural gas	518.51 MWh/year	64.65	6.1
Electricity	379.71 MWh/year	118.36	33.2

** Calculated under standard user pattern and outdoor conditions.*

Energy demands by month

Distribution of heating demand on different sources: Lighting; Auxiliary electricity; Domestic hot water; and Heating.

Energy demand by energy source



Energy consumption at Møllegården care centre is, as in most Danish buildings dominated by the energy consumption for space heating (above), but lighting plays an important role in this building due to the special needs for 24 hours a day service all year around.

	Annual losses			Annual gains			
Total heating kWh/m²	Total	Trans-mission	Ventila-tion	Total	Solar	Sun space	Internal heat
Zone 1	180	96	84	95	17	0	78
Zone 2	196	89	107	66	11	0	55
Zone 3	324	233	90	87	45	0	42
Zone 4	339	205	134	39	39	0	0
Total	**1039**	**623**	**415**	**287**	**112**	**0**	**175**

2.3 Calculation of energy savings: scenarios for improvement

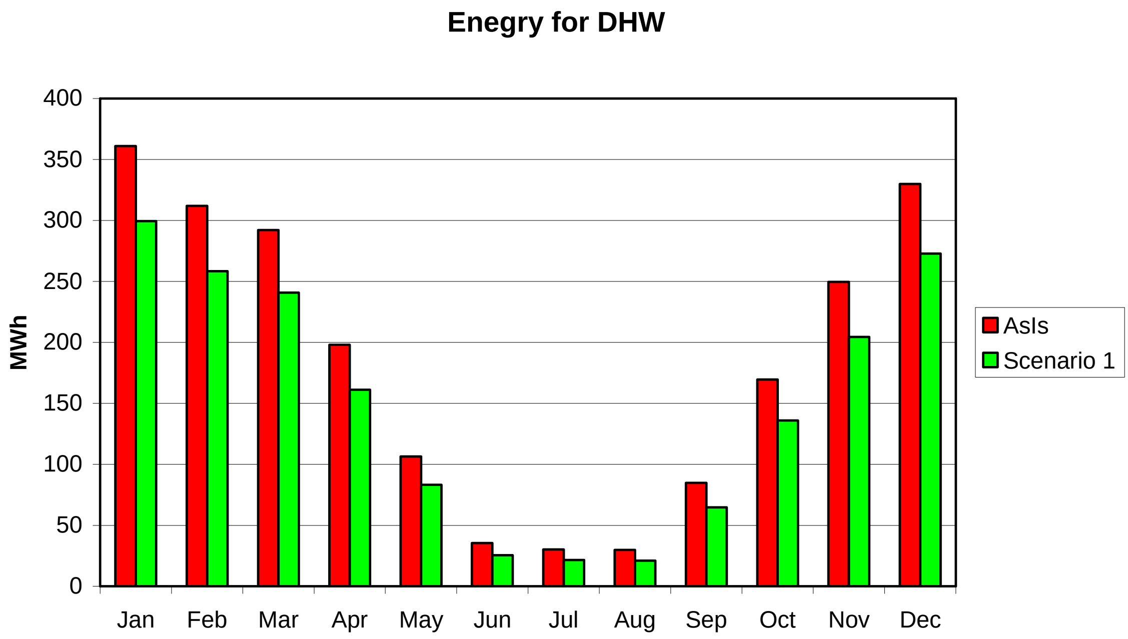
Some of the energy saving measures listed in this section is in line with the proposed renovation scenario from the consultant and some are based on the audit of the building. Some of the most obvious, small improvements are not part of the scenarios, but discussed in section 2.2.1., as the option will not exist in the renovated building.

2.3.1 Scenario 1 – New facades in sheltered dwellings

2.3.1.1 Background and proposed solution

The sheltered dwellings do not meet today's Danish standard for this type of dwelling and a major renovation is planned for the autumn of 2007. During this renovation, the facades will be replaced and straightened to increase the insulation level and the area of the dwellings. The floors in the bath-rooms will be replaced and additional insulation will be mounted. All windows will be upgraded to low-energy glazing and the doors to a similar standard. Insulation in the roof will be increased to 300 mm.

Seen upon as solely energy saving measures, these interventions will not be economically appropriate, but as the dwellings are having an upgrade anyway, the additional cost is marginal. When undertaking a radical renovation, as the one planned at Møllegården, the Danish Building Regulations requires that the new thermal envelope elements meets the requirements for new buildings, if at all possible due to economical (marginal) and architectural reasons.



Energy consumption for heating, before and after renovation of the sheltered dwellings section of the building complex.

The annual saving is calculated to 409 MWh equal to a cost of about € 51000 with an investment of one hour work or about € 830 000. This gives a simple pay-back time of 16 years.

2.3.1.2 Recommendation

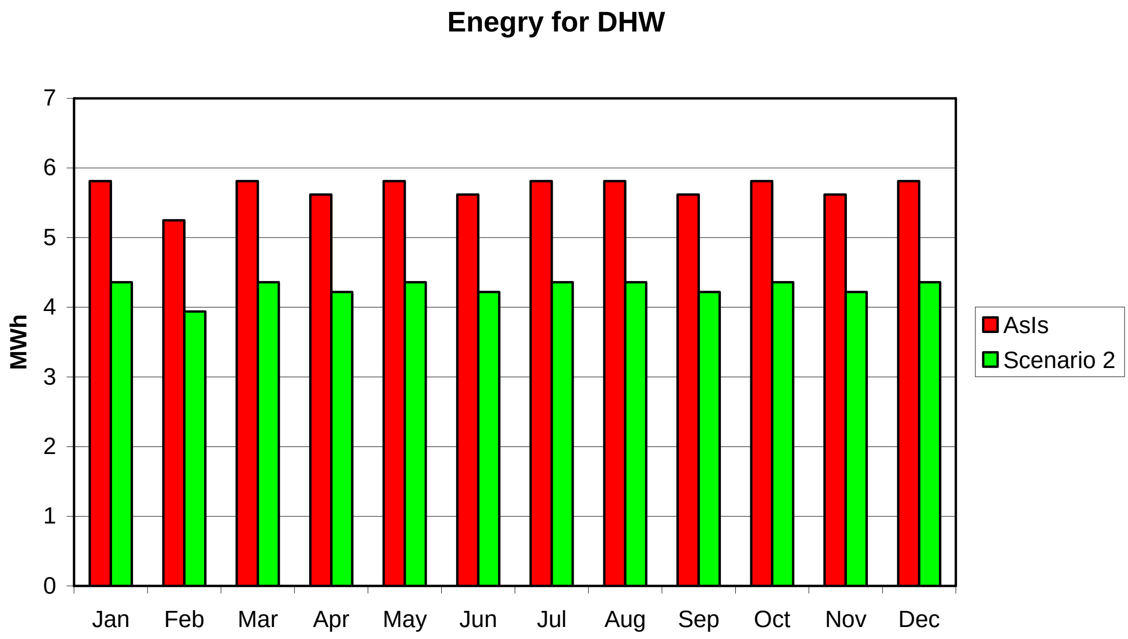
As the sheltered dwellings are going to be renovated anyway, energy saving measures is only a marginal cost. Further, energy saving measures that are economically sound (savings in money times life-time of the measure in years divided by the investment in money > 1.33) must be carried out when undertaking a major renovation in a Danish building. A renovation is major if it influences more than 25 % of the thermal envelope.

2.3.2 Scenario 2 – Derease of DHW circulation temperature

2.3.2.1 Background and proposed solution

The set-point temperature for the domestic hot water circulation is at the moment about 52 °C and can easily be decreased without causing any Legionnaires' disease problems. The distribution net-work for domestic hot water is about 1300 meters of relatively well insulated pipes located in the technical galleries in the basement.

As energy saving measure, this is a simple intervention that can be done by the technical staff of the school within about half an hour. The pay-back time does thus not exist.



Energy consumption for domestic hot water, before and after decreasing the water temperature in the distribution network. Estimated distribution efficiency changed from 0.6 to 0.8.

The annual saving is calculated to 17 MWh equal to a cost of about € 2100 with an investment of one hour work or about € 50.

2.3.2.2 Recommendation

It is highly recommended to carry out this measure, also after the renovation of the buildings.

3 Appendix 1: additional information about pilot projects

3.1 Health care building, Møllegården care center

Møllegården elderly peoples rest home and care centre have been under planning for an extensive renovation – including energy renovation - over the past 5-7 years, but no action have been taken yet. The building conditions do thus not meet what could be expected from similar buildings of the same type and age, especially when talking about the facilities for the elderly people. Møllegården is owned and managed by Gladsaxe municipality.

Elderly peoples nursing home.

Solar shading over all windows.

Bay windows at gables.

Veranda door to sheltered homes.


Convector on connection corridors.


Single glass windows above doors.


Window wall in sheltered homes.


Corridor in nursing section.


Distribution network.


Heating distribution central.

Control system for ventilation plant.

Laundry service, old machinery.

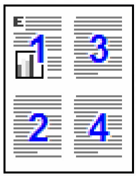
Restaurant and assembly hall.

Occupational therapy ward.

4 Appendix 2: inputs data for calculations

The following summary of inputs is taken directly from the EPA-NR calculation tool, exported into one pdf-file per pilot project.

The reproduction of the input summary should be read as indicated in the figure to the right.



4.1 Health care building, Møllegården care center

EnrModel: Møllegården — Created 18.06.2007 16.39

Building: Møllegården AsIs

Zone: Service centre	
Gross area, m²	1790
Specific internal heat capacity, kJ/m² K	165
Specific internal coupling coefficient, W/m² K	9,2
Int Temp Heating, °C	21
Int Temp Cooling, °C	30
Lighting	
Total installed lighting power, W	14320
Daylight time usage per year for lighting, hours	4380
Non-daylight time usage per year for lighting, hours	2190
Daylight dependency factor for lighting, -	0,5
Occupance factor for lighting, -	1
Fraction not removed by exhaust ventilation, -	0
Emergency lighting charging energy	no
Lighting controls stand-by energy	no
Invest	0
Heat Production / Fraction of time	
Occupants, W/m²	5,4
Fraction Persons present, -	0,16
Appliances, W/m²	20
Fraction Appliances are on, -	0,4
Airflow rate	
Infiltration, m³/s	0,537
Natural vent, m³/s	1,074
Fraction Nat Vent is present, -	0,5
Domestic hot water	
Average DHW consumption, m³/m²/year	0,062
Boiler Temp, °C	60
Cold-water Temp., °C	8

Opaque Construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	Alpha, -	R_se, m²K/W	F_h, -	F_o, -	F_f, -	Invest/m²
East Facade, South	125,0	90,0	90,0	0,400	0,65	0,04	0,800	0,700	1,000	0,00
East Facade, North	117,0	90,0	90,0	0,400	0,65	0,04	0,800	0,700	0,900	0,00
West Facade, South	119,0	270,0	90,0	0,400	0,65	0,04	0,700	0,700	1,000	0,00
West facade, North	101,0	270,0	90,0	0,400	0,65	0,04	0,700	0,700	0,900	0,00
South	112,0	180,0	90,0	0,400	0,65	0,04	0,800	1,000	0,700	0,00
North	112,0	0,0	90,0	0,400	0,65	0,04	0,600	1,000	0,700	0,00
Roof	895,0	1,0	0,0	0,250	0,80	0,04	1,000	1,000	1,000	0,00

Transparent construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	U_s, W/m²K	G_g, -	G_g_s, -	F_s, -	F_with, -	F_h, -	F_o, -	F_f, -	Invest/m²
Windows East, South	41,6	90,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,800	0,500	0,900	0,00
Windows East, North	23,9	90,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,700	0,500	0,700	0,00
Windows West, South	47,7	270,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,600	0,500	0,900	0,00
Windows West, North	40,0	270,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,600	0,500	0,700	0,00
South	29,3	180,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,800	0,950	0,700	0,00
North	29,3	0,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,700	0,950	0,700	0,00
	0,0	0,0	90,0	0,000	0,000	0,000	0,00	0,000	0,000	0,000	0,000	0,000	0,00

Ground construction

Name	Area, m²	U, W/m²K	B_g_h, -	B_g_c, -	Invest/m²
Floor	895,0	0,800	0,50	0,50	0,00

Service Centre AHU	
Fraction of time, -	1
Temp. rise by fans, °C	2
Invest	0
Heating part	
Active	true
Supply temp., °C	21
Mechanical ventilation, m³/s	2,2
Heat rec. eff, -	0,6
Recirc. factor, -	0
Cooling part	
Active	false
Supply temp., °C	0
Mechanical ventilation, m³/s	0
Cool rec. eff, -	0
Recirc. factor, -	0
Humidification part	
Active	false
Hum. supply air, g/kg	0
Eff. hum. recovery, -	0
Auxiliary fan energy	
Spec. electricity cons. for fans, Ws/m³	2600
Systems	
Heating	Common Heating System
Dhw	Common Dhw System

Common Heating System	
Factor on fuel consumption, -	1
Use Solar Collector	No

Aux energy and operation time fraction

Name	p_pump, W/m²	f_contr, -	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating Aux	0,3	1	1	1	1	1	1	1	1	1	1	1	1	1

Generator eff. and load contribution

Name	Efficiency, -	COP, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler	0,98	1	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
Common distribution network	0,8	0

Emission

Name	Efficiency, -	Invest
Radiators	0,9	0

Common Dhw System	
Factor on fuel consumption, -	1
Use Solar Collector	No

Generator eff. and load contribution

Name	Efficiency, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas															

boiler + water tank	0,8	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
DHW distibution w. circulation	0,6	0

Emission

Name	Efficiency, -	Invest
Taps etc	0,9	0

Zone: Nursing centre

Gross area, m²	2930
Specific internal heat capacity, kJ/m² K	165
Specific internal coupling coefficient, W/m² K	9,2
Int Temp Heating, °C	23
Int Temp Cooling, °C	30

Lighting

Total installed lighting power, W	23440
Daylight time usage per year for lighting, hours	4380
Non-daylight time usage per year for lighting, hours	2190
Daylight dependency factor for lighting, -	0,5
Occupance factor for lighting, -	1
Fraction not removed by exhaust ventilation, -	0
Emergency lighting charging energy	no
Lighting controls stand-by energy	no
Invest	0

Heat Production / Fraction of time

Occupants, W/m²	2,25
Fraction Persons present, -	1
Appliances, W/m²	4
Fraction Appliances are on, -	1

Airflow rate

Infiltration, m³/s	0,879
Natural vent, m³/s	1,172
Fraction Nat Vent is present, -	0,5

Domestic hot water

Average DHW consumption, m³/m²/year	0,062
Boiler Temp, °C	60
Cold-water Temp., °C	8

Opaque Construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	Alpha, -	R_se, m²K/W	F_h, -	F_o, -	F_f, -	Invest/m²
East	442,6	90,0	90,0	0,400	0,65	0,04	0,800	0,500	0,900	0,00
West	439,2	270,0	90,0	0,400	0,65	0,04	0,700	0,500	0,900	0,00
South	111,7	180,0	90,0	0,400	0,65	0,04	0,850	0,900	0,950	0,00
North	111,7	0,0	90,0	0,400	0,65	0,04	0,650	0,900	0,950	0,00
Roof	1465,0	180,0	0,0	0,250	0,80	0,04	1,000	1,000	1,000	0,00

Transparent construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	U_s, W/m²K	G_g, -	G_g_s, -	F_s, -	F_with, -	F_h, -	F_o, -	F_f, -	Invest/m²
East	61,4	90,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,700	0,500	0,900	0,00
West	64,8	270,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,650	0,500	0,900	0,00
South	29,3	180,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,800	0,900	0,700	0,00
North	29,3	0,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,600	0,900	0,700	0,00

Ground construction

Name	Area, m²	U, W/m²K	B_g_h, -	B_g_c, -	Invest/m²
Floor	1465,0	0,800	0,50	0,50	0,00

Nursing centre Ahu

Fraction of time, -	1
Temp. rise by fans, °C	2
Invest	0

Heating part

Active	true
Supply temp., °C	21
Mechanical ventilation, m³/s	3,6
Heat rec. eff, -	0,6
Recirc. factor, -	0

Cooling part

Active	false
Supply temp., °C	0
Mechanical ventilation, m³/s	0
Cool rec. eff, -	0
Recirc. factor, -	0

Humidification part

Active	false
Hum. supply air, g/kg	0
Eff. hum. recovery, -	0

Auxiliary fan energy

Spec. electricity cons. for fans, Ws/m³	2600

Systems

Heating	Common Heating System
Dhw	Common Dhw System

Common Heating System

Factor on fuel consumption, -	1
Use Solar Collector	No

Aux energy and operation time fraction

Name	p_pump, W/m²	f_contr, -	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating Aux	0,3	1	1	1	1	1	1	1	1	1	1	1	1	1

Generator eff. and load contribution

Name	Efficiency, -	COP, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler	0,98	1	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
Common distribution network	0,8	0

Emission

Name	Efficiency, -	Invest
Radiators	0,9	0

Common Dhw System

Factor on fuel consumption, -	1
Use Solar Collector	No

Generator eff. and load contribution

Name	Efficiency, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler + water tank	0,8	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
DHW distibution w. circulation	0,6	0

Emission

Name	Efficiency, -	Invest
Taps etc	0,9	0

Zone: Shetered dwellings

Gross area, m²	3180
Specific internal heat capacity, kJ/m² K	165
Specific internal coupling coefficient, W/m² K	9,2
Int Temp Heating, °C	22
Int Temp Cooling, °C	30

Lighting

Total installed lighting power, W	25440
Daylight time usage per year for lighting, hours	2190
Non-daylight time usage per year for lighting, hours	1095
Daylight dependency factor for lighting, -	0,5
Occupance factor for lighting, -	1
Fraction not removed by exhaust ventilation, -	0
Emergency lighting charging energy	no
Lighting controls stand-by energy	no
Invest	0

Heat Production / Fraction of time

Occupants, W/m²	1,6
Fraction Persons present, -	0,8
Appliances, W/m²	3,5
Fraction Appliances are on, -	1

Airflow rate

Infiltration, m³/s	0,954
Natural vent, m³/s	1,908
Fraction Nat Vent is present, -	0,5

Domestic hot water

Average DHW consumption, m³/m²/year	0,062
Boiler Temp, °C	60
Cold-water Temp., °C	8

Opaque Construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	Alpha, -	R_se, m²K/W	F_h, -	F_o, -	F_f, -	Invest/m²
Facade, East	117,0	90,0	90,0	0,400	0,65	0,04	0,800	0,700	0,800	0,00
Facade, West	117,0	270,0	90,0	0,400	0,65	0,04	0,800	0,700	0,800	0,00

Facades, south	645,0	180,0	90,0	0,400	0,65	0,04	0,900	0,900	1,000	0,00
Facades, North	645,0	0,0	90,0	0,400	0,65	0,04	0,850	0,500	1,000	0,00
Roof	3180,0	180,0	0,0	0,250	0,80	0,04	1,000	1,000	1,000	0,00

Transparent construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	U_s, W/m²K	G_g, -	G_g_s, -	F_s, -	F_with, -	F_h, -	F_o, -	F_f, -	Invest/m²
Windows, East	567,0	90,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,750	0,600	0,700	0,00
Windows, West	483,0	270,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,800	0,600	0,700	0,00
Windows, connections	54,0	0,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,700	0,600	0,900	0,00

Ground construction

Name	Area, m²	U, W/m²K	B_g_h, -	B_g_c, -	Invest/m²
Floor	2880,0	0,800	0,50	0,50	0,00
Floor heating in 50 bathrooms	300,0	0,500	0,70	0,70	0,00

Common Heating System

Factor on fuel consumption, -	1
Use Solar Collector	No

Aux energy and operation time fraction

Name	p_pump, W/m²	f_contr, -	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating Aux	0,3	1	1	1	1	1	1	1	1	1	1	1	1	1

Generator eff. and load contribution

Name	Efficiency, -	COP, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler	0,98	1	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
Common distribution network	0,8	0

Emission

Name	Efficiency, -	Invest
Radiators	0,9	0

Common Dhw System

Factor on fuel consumption, -	1
Use Solar Collector	No

Generator eff. and load contribution

Name	Efficiency, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler + water tank	0,8	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
DHW distibution w. circulation	0,6	0

Emission

Name	Efficiency, -	Invest
Taps etc	0,9	0

Zone: Connection building

Gross area, m²	120
Specific internal heat capacity, kJ/m² K	124
Specific internal coupling coefficient, W/m² K	9,2
Int Temp Heating, °C	20
Int Temp Cooling, °C	30

Lighting

Total installed lighting power, W	620
Daylight time usage per year for lighting, hours	4380
Non-daylight time usage per year for lighting, hours	4380
Daylight dependency factor for lighting, -	1
Occupance factor for lighting, -	1
Fraction not removed by exhaust ventilation, -	0
Emergency lighting charging energy	no
Lighting controls stand-by energy	no
Invest	0

Heat Production / Fraction of time

Occupants, W/m²	0
Fraction Persons present, -	0
Appliances, W/m²	0
Fraction Appliances are on, -	0

Airflow rate

Infiltration, m³/s	0,124
Natural vent, m³/s	0
Fraction Nat Vent is present, -	0

Domestic hot water

Average DHW consumption, m³/m²/year	0
Boiler Temp, °C	60
Cold-water Temp., °C	8

Opaque Construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	Alpha, -	R_se, m²K/W	F_h, -	F_o, -	F_f, -	Invest/m²
South	33,6	180,0	90,0	0,400	0,65	0,04	0,800	0,600	0,600	0,00
North	50,4	0,0	90,0	0,400	0,65	0,04	0,700	0,600	0,600	0,00
Roof	72,0	180,0	0,0	0,250	0,80	0,04	1,000	1,000	0,800	0,00

Transparent construction

Name	Area, m²	Orientation, deg	Tilt, deg	U, W/m²K	U_s, W/m²K	G_g, -	G_g_s, -	F_s, -	F_with, -	F_h, -	F_o, -	F_f, -	Invest/m²
South	33,6	180,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,800	0,500	0,600	0,00
North	16,8	0,0	90,0	3,000	3,000	0,720	0,72	0,000	0,000	0,650	0,500	0,600	0,00

Ground construction

Name	Area, m²	U, W/m²K	B_g_h, -	B_g_c, -	Invest/m²
Floor	70,0	0,800	0,50	0,50	0,00

Common Heating System

Factor on fuel consumption, -	1
Use Solar Collector	No

Aux energy and operation time fraction

Name	p_pump, W/m²	f_contr, -	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heating Aux	0,3	1	1	1	1	1	1	1	1	1	1	1	1	1

Generator eff. and load contribution

Name	Efficiency, -	COP, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler	0,98	1	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
Common distribution network	0,8	0

Emission

Name	Efficiency, -	Invest
Radiators	0,9	0

Common Dhw System

Factor on fuel consumption, -	1
Use Solar Collector	No

Generator eff. and load contribution

Name	Efficiency, -	Fuel	Invest	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Gas boiler + water tank	0,8	Natural gas, high energy	0	1	1	1	1	1	1	1	1	1	1	1	1

Distribution

Name	Efficiency, -	Invest
DHW distibution w. circulation	0,6	0

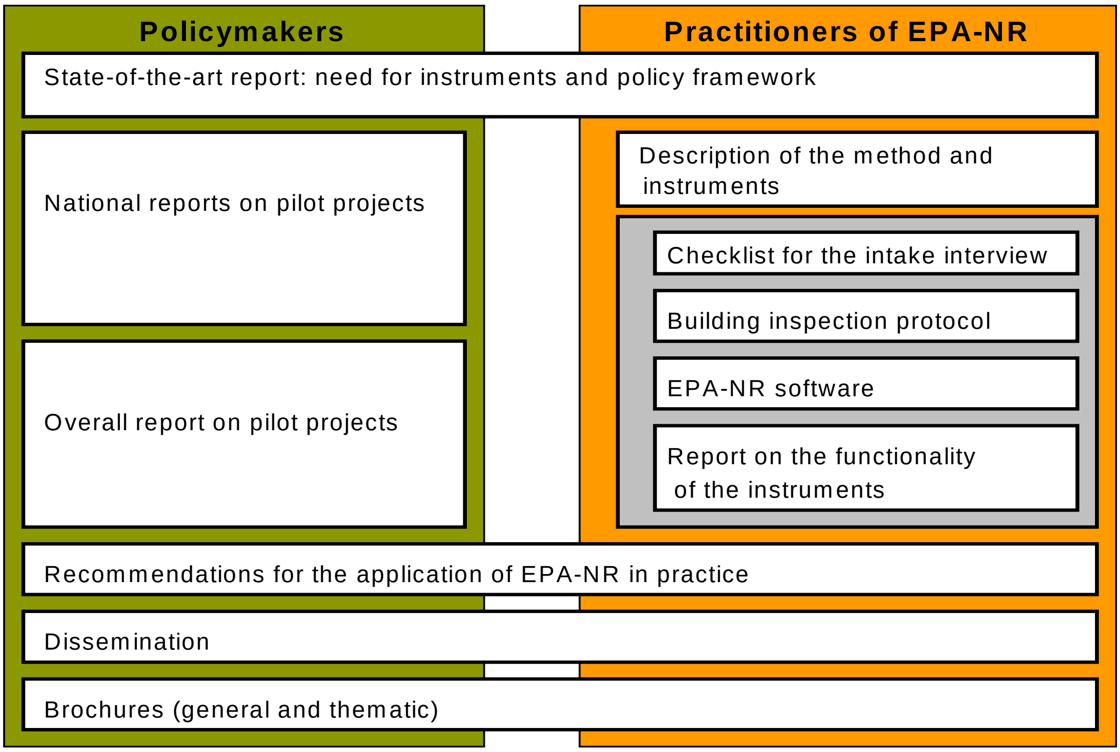
Emission

Name	Efficiency, -	Invest
Taps etc	0,9	0

Project Description

EPA-NR is a project in the framework of the 'Intelligent Energy – Europe' Programme (IEE) of the European Commission. EPA-NR provides an assessment method for the Energy Performance Certificate according to the Energy Performance of Buildings Directive (EPBD) and offers additional advice for existing non residential buildings. The project, in which seven EU Member States are participating, is co-ordinated by EBM-consult, The Netherlands. It started in January 2005 and will last for two years.

The EPA-NR method consists of an energy calculation model and process supporting tools like inspection protocols, checklists and building component libraries. The EPA-NR method produces an Energy Performance Certificate for non-residential buildings with the possibility for additional advice. The two major target groups are policy makers and practitioners who are each addressed with a tailored set of deliverables.



The EPA-NR method:

- is in line with the EPBD and CEN-standards
- takes into account the local framework with respect to legislation, technical aspects, design- and building maintenance processes and acceptance by actors in the market
- is modular and flexible and therefor easily adjustable to the national context, the diversity in the market and new or modified CEN-standards
- is tested through pilot projects in seven EU Member States
- can be further developed and maintained at low cost due to the joint efforts
- offers additionally policy recommendations addressing all levels of authorities in Europe
- guarantees simple transfer to all EU Member States

Project Partners

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